A Comparison of Signal Pre-emption and Priority for Emergency Vehicle Response

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First responders are always looking to reduce their travel times to incidents. A crucial step in overcoming this task is the ability for emergency vehicles to pass through signalized intersections and less interruptions from surrounding vehicular traffic.
Traffic signal pre-emption is the most widely used system by Public Safety for emergency vehicle response.
For pre-emption, emergency vehicles are equipped with strobe-based emitters in which, depending on the technology, use a variety of different spectra, such as radio or infrared. Depending on which technology is used, a detector, or group of detectors is installed at the signalized intersection. When the detectors receive an acceptable incoming transmission, a relay is sent to the traffic controller to preempt the signal for the oncoming emergency vehicle.
Preemption works by forcing the controller out of its current operation and into a preconfigured pre-emptive state. Once the traffic controller receives a preempt signal, it begins the sequence to bring the controller into the preemptive state. This includes terminating vehicle phases, overlaps, and pedestrian phases not called for in the preemption.

Vehicle components: control unit, radio/GPS antenna, radio unit.

Intersection components: GPS receiver/radio, phase selector.
Pre-emption
Overview

**Positives**
Reliable
Simple logic, limited software setup
Emergency vehicle has control

**Negatives**
Range Issues (line of sight, cone)
Obstructive to other traffic
Can take long time to return to normal coordination
Not always guaranteed
More field equipment to maintain
Snowplow effect
Equipment costs
Priority is a system in which the traffic controller never leaves coordination. It can be user-defined in how the controller services the priority request giving much greater flexibility to the traffic engineer. Because priority works with a user configured set of limits, a green signal for the vehicle requesting priority service cannot be guaranteed.
Priority can work with the same emitter based technology used in preemption, or be controlled by a communications based estimated time of arrival system.
For emitter based use, when the controller receives the request for service by the vehicle, it will attempt to provide a green signal by either going short in the cycle to allow for an early green, going long to extend the green, or doing nothing if the requesting vehicle will be arriving on green with no adjustment.
When using a communications based system, the system can monitor the vehicle’s location and provide estimated time of arrivals to the various signalized intersections along the route minutes before the vehicle’s arrival. The earlier the traffic controller receives the estimated time of arrival, the more time it has to adjust its cycle for the priority vehicle with the least amount of traffic disruption.
Today, priority is mostly associated with transit rather than emergency vehicles. With the introduction of communications based priority traffic control, a traffic controller will know much earlier when a vehicle is expected to arrive. This now allows priority control to become a viable option for emergency vehicles.
My research will only include communications based priority.
Positives
No more range/line of sight issues
No hardware to maintain
Automated control system knows the route ahead of time
Cannot be abused by vehicles
Software is upgradeable
Has potential to clear out traffic and eliminate plow effect

Negatives
Relies on the communications infrastructure (fiber, wireless, GPS, CAD system)
Driver needs to use generated route
Green is not guaranteed
Proposed Research

The research intends to investigate the differences of using an emitter-based preemption system with that of a communications-based priority system for emergency vehicle response.
The research will use a microscopic simulation approach—specifically, the CORSIM traffic simulation program.

To facilitate this, a RTE (Run Time Extension) has to be developed for the controller logic required to run this type of system (essentially a software-in-the-loop simulation approach). We are currently working with McTrans to develop and implement this RTE.
The comparative analysis will include the same simulated Gainesville arterials with:

- No emergency vehicles
- Pre-emption
- Priority

Multiple runs will be performed with the emergency vehicle entering at different times.
Performance measures for the comparisons will include:

- Delay
- Stops
- v/c ratios
- Travel time (emergency vehicle & surrounding traffic)
The findings from the preemption and priority runs will be compared to that of the non-disrupted simulation. Conclusions will then be drawn about how each type of emergency vehicle model performed as compared to the non-disrupted run.
Conclusions will be drawn regarding the differences in traffic disruption, emergency vehicle travel times, and whether communications-based priority control should be considered as another option for emergency vehicle response through signalized intersection systems.
UF Signal Cabinet
Thank you! Questions?